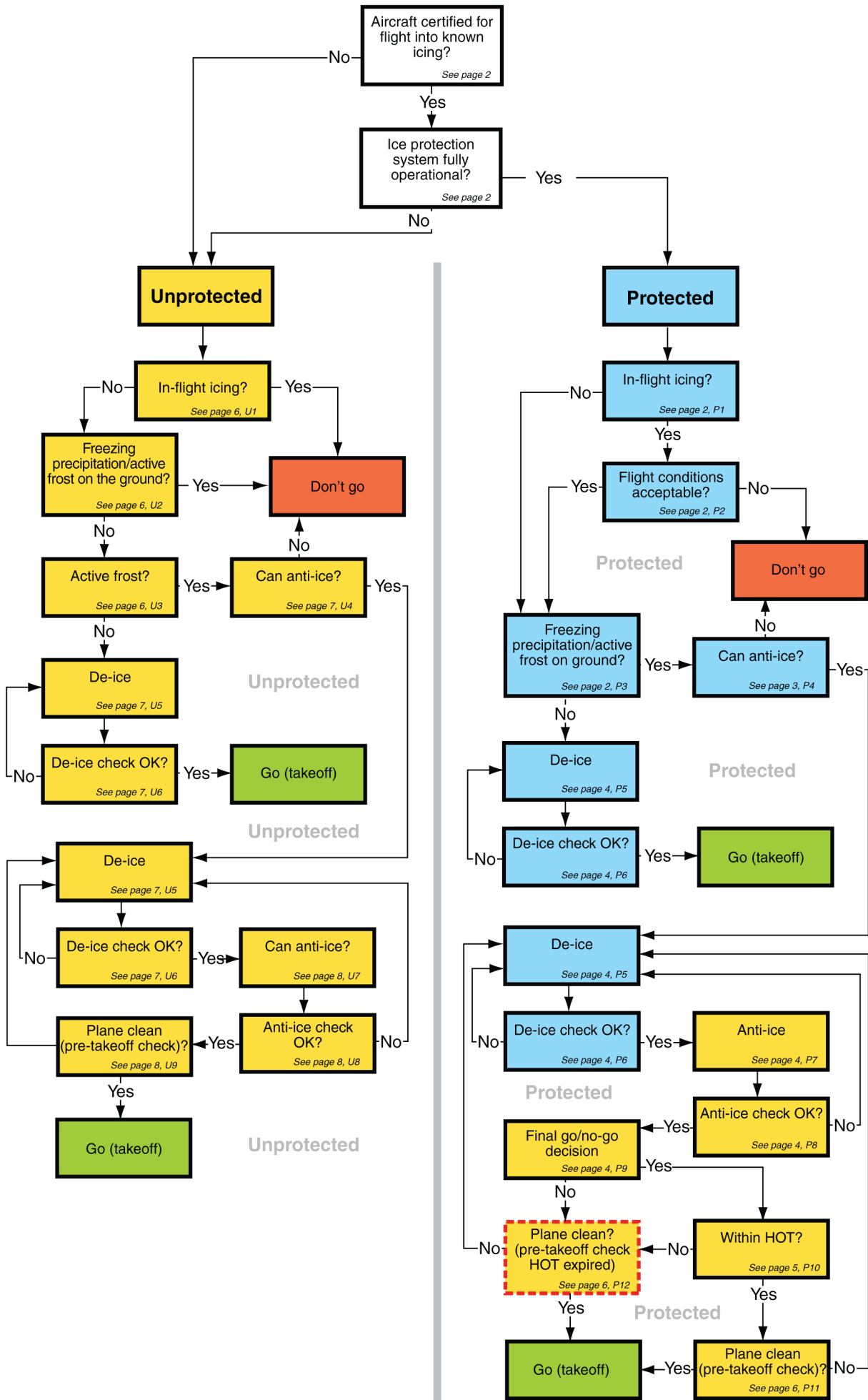


## Decision Making Flow Chart



# Ground Icing Checklist – How Do I Know Text

## 1. Aircraft certified for flight into known icing?

Ice protection systems may be installed on aircraft without any demonstration that this equipment is able to protect the aircraft in icing. The only requirement is that the equipment not interfere with the operation of the aircraft. Even some business jet systems are not certified for flight into known icing.

If your aircraft is certified for flight into known icing it will be clearly stated in the Aircraft Flight Manual (AFM) or Pilot's Operating Handbook (POH).

For more information see A Pilot's Guide to In-flight Icing

## 2. Ice protection system fully operational?

Ice protection systems should be tested prior to departure into potential icing conditions. If the system is not fully operational, entering icing conditions would be hazardous and the aircraft would not be considered certified for flight into known icing.

The preflight testing procedure for your ice protection system (IPS) is documented in information supplied by the manufacturer. The IPS may include separate systems to protect sensors, propellers, engine inlets, wings, windows, and the tail.

**Heated.** Check that an appropriate electrical load registers when the system is activated or that no load is registered if a squat switch inhibits the system. Verify switch positions for bleed air systems prior to takeoff.

**Pneumatic.** Check that pneumatic boot systems are free of holes, that patches (if any) adhere fully to the boot, and that the boots cycle and fully inflate in both the automatic and manual modes.

**Fluid.** Check that reservoirs are full, that no leaks are visible, and that the fluid flows normally throughout the system.

For more information see A Pilot's Guide to In-flight Icing

# PROTECTED AIRCRAFT – How Do I Know Text

## P1. In-flight icing?

Before you consider de-icing, determine whether you can safely fly in the weather that you will encounter after departure. Check conditions at your departure and destination airports and en route. If icing is forecast, be sure that you and your aircraft can handle the forecast conditions and that you have a plan for exiting any icing that you encounter.

In the United States, icing is forecast in Airmet Zulu. More detailed information about icing is available in the Current Icing Product (CIP) and Forecast Icing Product (FIP) available on the Aviation Weather Center website. For a detailed discussion of icing-related weather planning, see A Pilot's Guide to In-flight Icing.

## P2. Flight conditions acceptable?

If your aircraft is certified for flight into known icing, it is capable of transiting through some icing conditions. However, you should not linger in icing. You should use your ice protection system to safely exit from icing. Before you begin your flight, develop a plan that will allow you

to exit from icing anywhere along your route. Alter your planned route or altitude to ensure that you are always able to exit from any icing that you may encounter.

Certification for flight into known icing does not mean that the aircraft is capable of prolonged flight in all icing conditions. For certification, manufacturers are not required to test aircraft in large droplet icing (SLD) conditions such as freezing rain. If you attempt to fly in these conditions without knowing that your aircraft has been tested in them, you will be acting as a test pilot. Do not depart. In the United States, SLD conditions are forecast in the Aviation Weather Center's Current Icing Potential (CIP) and Forecast Icing Potential (FIP) products.

For more information about icing certification and planning for in-flight icing see A Pilot's Guide to In-flight Icing.

### **P3. Freezing precipitation/active frost on ground?**

Freezing/frozen precipitation is readily observable and is reported in METAR's and forecast in TAF's. In addition, beware of rain or drizzle at near freezing temperatures. There may be local variations in temperature that can result in freezing rain where you are parked. Also, precipitation may freeze on the aircraft if the aircraft surface is below freezing when the ambient temperature is above freezing. Frost is not included in aviation weather products in the United States. However, frost information can be obtained from other weather services including the National Weather Service. Ice can also form on an aircraft when there is no precipitation or frost if there is sufficient moisture in the air and the aircraft surface is below freezing. This typically occurs when the aircraft has been flying in cold temperatures aloft so that the fuel in the tanks is cold-soaked.

In any of these conditions, ice will accrete on the aircraft shortly after it is de-iced so other steps must be taken to ensure that the aircraft is free of contamination before departure. For more information, see the "Cues" section of A Pilot's Guide to Ground Icing.

### **P4. Can anti-ice?**

Anti-icing fluids are designed to mix with freezing precipitation so that the resulting mixture has a substantially lower freezing point than water. The fluid will protect the aircraft until the mixture is diluted by the precipitation to the point that it begins to freeze. In general, the more viscous fluids can absorb more freezing precipitation and will protect the aircraft for longer periods of time. However, these fluids will not flow off the aircraft as easily as the less viscous fluids. This can be a problem for some aircraft. If the anti-icing fluid were to remain on the aircraft during the takeoff roll, it would itself become a contaminant and adversely affect the aircraft's performance or handling.

Therefore, to determine if it makes sense to anti-ice your aircraft, you must determine what fluids are available and whether these can be applied to your aircraft (see table below). You must also determine whether the applicable fluids will protect your aircraft long enough for you to complete ground operations and depart before they fail. This information is included in the Hold-Over Time (HOT) tables.

For more information about anti-icing fluids see the De/Anti-Icing Fluid Basics section of A Pilot's Guide to Ground Icing. For more information about using HOT tables, see the Anti-Icing section of A Pilot's Guide to Ground Icing.

Fluid (all SAE)	Color	Minimum Rotation Speed	Sample HOT for Moderate Snow (hr:min)
Type I	red-orange	No minimum	0:06
Type II	clear or straw	100 knots	0:20
Type III	yellow-green	60 knots	0:10
Type IV	emerald green	100 knots	0:30

## **P5. De-ice?**

You can de-ice an aircraft using heat (from a hangar or portable heater), scrapers (or brooms or other tools), and de-icing fluids. Hot air can be used to de-ice spinners, propellers, engine intake areas, turbine engine fan blades, and landing gear. Scrapers (and other tools) can be used to remove ice, but be careful not to damage sensors or Plexiglas. Be sure that the ice has been removed, not just smoothed. De-icing with fluids is accomplished primarily by the heat and hydraulic force of the spray. De-icing fluid should be applied with a forceful, narrow, spray to maximize the hydraulic force that removes the contamination. Rising steam indicates that the fluid is sufficiently heated. Do not spray de-icing fluid directly into sensors or engine or APU intakes. Check your AFM for other possible no spray zones. For more information on de-icing procedures, see the De-Icing section of A Pilot's Guide to Ground Icing.

## **P6. De-ice check OK?**

After de-icing, check that ALL ice has been removed and that fluid has not collected in the control surface gaps. Run your hand along the aircraft surface to be sure that there is no ice remaining. Clear ice is very difficult to see. Make sure that ALL of the aircraft is ice-free. Small residual patches of ice may be sufficient to cause roll or pitch upsets. If there is any ice remaining, continue de-icing until it is all gone. For more information on de-icing procedures, see the De-Icing section of A Pilot's Guide to Ground Icing.

## **P7. Anti-ice?**

Anti-icing fluid will protect your aircraft for a limited time in active frost and most (not all) active precipitation. These fluids work by forming a layer that absorbs and melts the frost or precipitation. The length of time for which the aircraft is protected depends on: air temperature – the colder it is, the faster a fluid will fail, precipitation type and intensity – the higher the moisture content, the faster a fluid will fail, and fluid type and strength – the thinner the fluid is, the faster it will fail. Estimates for the amount of time that your aircraft will be protected can be found in Hold-Over Time (HOT) tables. NO fluid will protect your aircraft after rotation. Some fluids (e.g., Type II, IV) cannot be used on aircraft with rotation speeds less than 100 knots. These fluids may not shear off during the takeoff roll. Using these fluids on slow aircraft could cause roll or pitch upsets.

Anti-icing fluids must be applied to clean aircraft. Do not spray anti-icing fluid directly into sensors or engine or APU intakes. Check your AFM for other possible no spray zones.

For more information on anti-icing procedures, see the Anti-Icing section of A Pilot's Guide to Ground Icing.

## **P8. Anti-ice check OK?**

After anti-icing be sure that there is a uniform layer of anti-icing fluid over the entire aircraft and that fluid has not collected in the control surface gaps. For more information on anti-icing procedures, see the Anti-Icing section of A Pilot's Guide to Ground Icing.

## **P9. Final go/no-go decision**

Immediately before takeoff, make sure that the aircraft is still free from frozen contamination.

If you operate under a regulatory approved de/anti-icing program or have an Air Operator Certificate (AOC), follow your training. If not, consider the elements such operators follow. These operators follow strict guidelines that cover every aspect of the de/anti-icing process to ensure that the de/anti-icing fluid has been applied properly. With this, they have high confidence that they can achieve the published HOT times. Guidelines for the final Go/No-Go decision are based on whether or not they are within the HOT (pre-takeoff check) or it has been exceeded (pre-takeoff contamination check). If within the HOT, pilots typically are allowed to conduct quicker and simpler pre-takeoff checks. For more information on anti-icing programs, see the Anti-Icing section of A Pilot's Guide to Ground Icing.

## P10. Within HOT?

Estimates for the amount of time that your aircraft will be protected can be found in Hold-Over Time (HOT) tables. The length of time for which the aircraft is protected depends on: air temperature (the colder it is, the faster a fluid will fail), precipitation type and intensity (the higher the moisture content, the faster a fluid will fail), and fluid type and strength (the thinner the fluid is, the faster it will fail). The time range listed in the HOT cell is the time for which the aircraft should be protected. The time range reflects the range of intensities within the specific temperature/precipitation conditions. Shorter times correspond to heavier intensities. The holdover time clock starts at the BEGINNING of the anti-icing process and ends at takeoff or when the fluid fails. However, YOU SHOULD NOT TAKEOFF without performing a pre-takeoff check to ensure that the aircraft is free from ice. The HOT is a guideline, not a guarantee. For more information on HOT tables, see the Anti-Icing section of A Pilot's Guide to Ground Icing.

**SAE TYPE I Holdover Time Guideline (Sample)**

Outside Air Temperature <sup>2, TC</sup>		Approximate Holdover Times Under Various Weather Conditions (hours: minutes)								
°C	°F	Active Frost	Freezing Fog	Snow/Snow Grains			Freezing Drizzle	Light Freezing Rain	Rain on Cold Soaked Wing	Other
				<u>Very Light</u>	<u>Light</u>	<u>Moderate</u>				
-3 and above	27 and above	0:45	0:11 - 0:17	0:18-0:22*	0:11 - 0:18*	0:06 - 0:11*	0:09 - 0:13	0:02 - 0:05	0:02-0:05	
below -3 to -6	below 27 to 21	0:45	0:08 - 0:13	0:14-0:17	0:08 - 0:14	0:05 - 0:08	0:05 - 0:09	0:02 - 0:05	CAUTION: No holdover time guidelines exist	
below -6 to -10	below 21 to 14	0:45	0:06 - 0:10	0:11-0:13	0:06 - 0:11	0:04 - 0:06	0:04 - 0:07	0:02 - 0:05		
below -10	below 14	0:45	0:05 - 0:09	0:07-0:08	0:04 - 0:07	0:02 - 0:04				

## P11. Plane clean? (pre-takeoff check)

Being within the HOT time does not guarantee the fluid is still protecting your aircraft. Precipitation changes, jet blasts and other factors could shorten the time substantially.

Do not depart unless you are SURE that your aircraft is ice-free. Immediately prior to take-off you should again inspect the aircraft to be sure that the anti-icing fluid has not failed and the aircraft is still free from frozen contamination.

Begin with a thorough visual inspection. In some aircraft under some conditions, you may be able to conduct a satisfactory pre-takeoff inspection from the cockpit. In other aircraft or under other conditions, you may need to go into the cabin to conduct your inspection. In other cases, you may need to exit the aircraft to be reasonably certain that the fluid has not failed.

If you have any doubts, exit the aircraft and conduct a tactile inspection. At a busy airport, ATC often will accommodate a request to move out of the takeoff queue to conduct this sort of inspection, but you may need to taxi back to the ramp. Do whatever you need to do to make sure the aircraft is free from frozen contaminants before you take the runway.



## **P12. Plane clean? (pre-takeoff check HOT expired)**

If the HOT has expired take a moment to consider where you are. This is an area where the fluids are expected to fail and frozen contamination is expected to start sticking to your wings. Extreme caution is warranted if you decide to continue once in this area.

Do not depart unless you are SURE that your aircraft is ice-free. Immediately prior to take-off you should again inspect the aircraft to be sure that the anti-icing fluid has not failed and the aircraft is still free from frozen contamination.

Begin with a thorough visual inspection. In some aircraft under some conditions, you may be able to conduct a satisfactory pre-takeoff inspection from the cockpit. In other aircraft or under other conditions, you may need to go into the cabin to conduct your inspection. In other cases, you may need to exit the aircraft to be reasonably certain that the fluid has not failed.

If you have any doubts, exit the aircraft and conduct a tactile inspection. At a busy airport, ATC often will accommodate a request to move out of the takeoff queue to conduct this sort of inspection, but you may need to taxi back to the ramp. Do whatever you need to do to make sure the aircraft is free from frozen contaminants before you take the runway.

## **UNPROTECTED AIRCRAFT – How Do I Know Text**

### **U1. In-flight icing**

Before you consider de-icing, determine whether you can safely fly in the weather that you will encounter after departure. Check conditions at your departure and destination airports and en route. If icing is expected anywhere along your planned flight path, check alternate routes or altitudes. If you cannot find a route that is ice-free, DO NOT DEPART.

In the United States, icing is forecast in Airmet Zulu. More detailed information about icing is available in the Current Icing Product (CIP) and Forecast Icing Product (FIP) available on the Aviation Weather Center website. For a detailed discussion of icing-related weather planning, see A Pilot's Guide to In-flight Icing.

### **U2. Freezing precipitation/active frost on ground?**

Freezing/frozen precipitation is readily observable and is reported in METAR's and forecast in TAF's. In addition, beware of rain or drizzle at near freezing temperatures. There may be local variations in temperature that can result in freezing rain where you are parked. Also, precipitation may freeze on the aircraft if the aircraft surface is below freezing when the ambient temperature is above freezing.

Because you cannot depart in freezing precipitation, your only option is to delay departure until conditions improve.

### **U3. Active frost?**

Frost is not included in aviation weather products in the United States. However, frost information can be obtained from other weather services including the National Weather Service. Ice can also form on an aircraft when there is no precipitation or frost if there is sufficient moisture in the air and the aircraft surface is below freezing. This typically occurs when the aircraft has been flying in cold temperatures aloft so that the fuel in the tanks is cold-soaked.

In any of these conditions, ice will accrete on the aircraft shortly after it is de-iced so other steps must be taken to ensure that the aircraft is free of contamination before departure. For more information, see the "Cues" section of A Pilot's Guide to Ground Icing.

#### U4. Can anti-ice?

Anti-icing fluids are designed to mix with freezing precipitation so that the resulting mixture has a substantially lower freezing point than water. The fluid will protect the aircraft until the mixture is diluted by the precipitation to the point that it begins to freeze. In general, the more viscous fluids can absorb more freezing precipitation and will protect the aircraft for longer periods of time. However, these fluids will not flow off the aircraft as easily as the less viscous fluids. This can be a problem for some aircraft. If the anti-icing fluid were to remain on the aircraft during the takeoff roll, it would itself become a contaminant and adversely affect the aircraft's performance or handling.

Therefore, to determine if it makes sense to anti-ice your aircraft, you must determine what fluids are available and whether these can be applied to your aircraft (see table below). You must also determine whether the applicable fluids will protect your aircraft long enough for you to complete ground operations and depart before they fail. This information is included in the Hold-Over Time (HOT) tables.

For most small general aviation aircraft, only Type I or Type III fluid may be used. Type I fluid is expected to protect against active frost for approximately 45 minutes.

For more information about anti-icing fluids see the De/Anti-Icing Fluid Basics section of A Pilot's Guide to Ground Icing. For more information about using HOT tables, see the Anti-Icing section of A Pilot's Guide to Ground Icing.

Fluid (all SAE)	Color	Minimum Rotation Speed
Type I	red-orange	No minimum
Type II	clear or straw	100 knots
Type III	yellow-green	60 knots
Type IV	emerald green	100 knots

#### U5. De-ice?

You can de-ice an aircraft using heat (from a hangar or portable heater), scrapers (or brooms or other tools), and de-icing fluids. Hot air can be used to de-ice spinners, propellers, engine intake areas, turbine engine fan blades, and landing gear. Scrapers (and other tools) can be used to remove ice, but be careful not to damage sensors or Plexiglas. Be sure that the ice has been removed, not just smoothed. De-icing with fluids is accomplished primarily by the heat and hydraulic force of the spray. De-icing fluid should be applied with a forceful, narrow, spray to maximize the hydraulic force that removes the contamination. Rising steam indicates that the fluid is sufficiently heated. Do not spray de-icing fluid directly into sensors or engine or APU intakes. Check your AFM or POH for other possible no spray zones. For more information on de-icing procedures, see the De-Icing section of A Pilot's Guide to Ground Icing.

#### U6. De-ice check OK?

After de-icing, check that ALL ice has been removed and that fluid has not collected in the control surface gaps. Run your hand along the aircraft surface to be sure that there is no ice remaining. Clear ice is very difficult to see. Make sure that ALL of the aircraft is ice-free. Small residual patches of ice may be sufficient to cause roll or pitch upsets. If there is any ice remaining, continue de-icing until it is all gone. For more information on de-icing procedures, see the De-Icing section of A Pilot's Guide to Ground Icing.

## **U7. Can anti-ice?**

Anti-icing fluid will protect your aircraft for a limited time in active frost. These fluids work by forming a layer that absorbs and melts the frost or precipitation. The length of time for which the aircraft is protected depends on: air temperature – the colder it is, the faster a fluid will fail, precipitation type and intensity – the higher the moisture content, the faster a fluid will fail, and fluid type and strength – the thinner the fluid is, the faster it will fail. Estimates for the amount of time that your aircraft will be protected can be found in Hold-Over Time (HOT) tables. NO fluid will protect your aircraft after rotation. Some fluids (e.g., Type II, IV) cannot be used on aircraft with rotation speeds less than 100 knots. These fluids may not shear off during the takeoff roll. Using these fluids on slow aircraft could cause roll or pitch upsets.

Anti-icing fluids must be applied to clean aircraft. Do not spray anti-icing fluid directly into sensors or engine or APU intakes. Check your AFM or POH for other possible no spray zones.

For more information on anti-icing procedures, see the Anti-Icing section of A Pilot's Guide to Ground Icing.

## **U8. Anti-ice check OK?**

After anti-icing be sure that there is a uniform layer of anti-icing fluid over the entire aircraft and that fluid has not collected in the control surface gaps. For more information on anti-icing procedures, see the Anti-Icing section of A Pilot's Guide to Ground Icing.

## **U9. Plane clean? (pre-takeoff check)**

Immediately before takeoff, make sure that the aircraft is still free from frozen contamination. It is very difficult to determine when anti-icing fluid has failed from the cockpit. If conditions have worsened since you anti-iced or if the fluid was not properly applied, you may have less protection than you expect. If you have any doubt, exit the aircraft and verify that the aircraft is clear of any contamination by running your hand over the aircraft surface or taxi back for another round of de/anti-icing. Pay special attention to the leading edge and upper surface of the wings and the leading edge and lower surface of the horizontal stabilizer. For more information on how to conduct a pre-takeoff contamination check, see the Anti-Icing section of A Pilot's Guide to Ground Icing.